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The effects of on-line math games and e-books use on elementary student achievement

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Abstract

Game-based learning and the use of e-books is becoming increasingly more supported in classrooms as methods of increasing both student engagement and student achievement in all curricular areas. The purpose of this literature review is to examine current research on the effects of online math games and e-books on elementary student engagement and academic achievement. Over thirty peer-reviewed journal articles published in the last ten years are critically reviewed and analyzed. The findings show that online game-based learning and e-books can be effective tools within the confines of the elementary classroom, as long as careful consideration is given to student learning attitudes, how the e-books and online games are integrated into the curriculum, and the fidelity in which these programs are being used. Recommendations for educators are given for future inclusion of online game-based learning and digital texts in their own classrooms.

THE EFFECTS OF ON-LINE MATH GAMES AND E-BOOKS USE
ON ELEMENTARY STUDENT ACHIEVEMENT

A Graduate Review
Submitted to the
Division of Instructional Technology
Department of Curriculum and Instruction
In Partial Fulfillment
Of the Requirements for the Degree
Master of Arts
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by
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Game-based learning and the use of e-books is becoming increasingly more supported in classrooms as methods of increasing both student engagement and student achievement in all curricular areas. The purpose of this literature review is to examine current research on the effects of online math games and e-books on elementary student engagement and academic achievement. Over thirty peer-reviewed journal articles published in the last ten years are critically reviewed and analyzed. The findings show that online game-based learning and e-books can be effective tools within the confines of the elementary classroom, as long as careful consideration is given to student learning attitudes, how the e-books and online games are integrated into the curriculum, and the fidelity in which these programs are being used. Recommendations for educators are given for future inclusion of online game-based learning and digital texts in their own classrooms.

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Introduction

Let me introduce you to a child of the 21st century. They have always had a computer, a cell phone and a digital television. According to a recent report on the new digital media habits of young children (Gutnick, Robb, Takeuchi & Kotler, 2010), children spend 5.5 hours interacting digitally, and the use of handheld devices for games, music and video streaming is on the rise. They are more likely than their older counterparts to state that technology makes learning easier, and are more comfortable multitasking between digital components such as laptops, tablets, televisions and stereos. Children as young as four have increasingly sophisticated digital lives, and 10 year olds are spending up to 1.25 hours daily playing digital games (Levine & Vaala, 2013). The prevalence of digital media in today's society, along with greater access to the internet and the resources it provides, has spurred schools and educators to reconsider their educational practices in relation to the use of digital games as a method to improve student engagement, peer interaction, and achievement (Kiger, Herro & Prunty, 2012).

In 2012, President Obama appointed an expert adviser to create the first national policy initiative on digital games' roles in education (Levine & Vaala, 2013), and in 2010 launched a national effort to develop educational digital games in cooperation with a wide range of philanthropic children's organizations, indicating the how widespread digital gaming and its potential has become. Quest to Learn is one example of a public school in the US, in which 'game-like learning' is proving to engage and empower their students, and research on the 'social gamification' of education, in which teachers have the ability to deliver and maintain content for their students and parents on sites such as www.schoooooools.com, are beginning to gain popularity (Simoes, Redondo & Vilas, 2013). But, as Becker (2007) learned as she designed and taught a graduate level course primarily for teachers on digital game based learning, teachers

cannot be expected to embrace digital games as a tool for learning unless they have a solid understanding of the potential of those games as well as their limitations. Within the context of this course, all participants were ‘converts’, each seeing that digital games do have potential in the classroom as long as proper training, and planning is including in their implementation.

Knowing that digital tools such as online gaming and e-books are being widely used in classrooms today, understanding the effects these new tools might be having on student achievement is vital for educators. The purpose of this literature review is to examine current research on online math games and the use of e-books in the elementary classroom, how those programs affect engagement, and how online games and e-books affect student achievement. Such information is important to guide educators to make decisions in their own classrooms about online gaming and the use of online reading formats(Becker, 2012; McKenna, 2012). The need for making a connection between educational technology and student learning is becoming more necessary as schools are incorporating more 1:1 initiatives in their districts. Understanding this connection can also serve as a guide for making implementation decisions for schools (Kiger, Herro & Prunty, 2012). As schools begin to shift their focus to 21st century skills, in which learner inquiry and critical thinking skills are fundamental, the use of digital resources has shifted to the forefront of the educational platform, and many schools have begun to consider how they might use technology to empower their students (Kong et al. 2014).

This review focuses on the use of online math games and e books in the elementary classroom, and the first question for guiding this review is, “How does the use of digital tools such as online math games and e books effect student achievement in the areas of reading and math?” Underlying factors such as engagement and motivation, teacher preparedness, and the quality and types of the e-books and games being used must be considered, therefore, the other

two questions for this review are “How does student engagement affect student achievement in the area of online math games and e-books?” and “What factors affect the success of online math games and e-books?”

Methodology

Search Strategy

Relevant research regarding e-readers and online math games, student engagement and student achievement was identified by searching the UNI Rod Library's One Search, EBSCO's Integrated One Search, the ERIC database, as well as Google Scholar. In order to obtain articles related to online learning in areas of math and reading, but also give background information about the success of online learning in general, several search terms were used. The following keywords were used in different combinations to retain varied results: *'e-readers, digital reading, math games online, student engagement and games, student achievement, iPads in the elementary classroom, technology integration and elementary*. Studies were eligible for review if the focus of the study included data related to online math games or e-readers and student achievement, student engagement, or successful ways digital games and e-readers have been used in the classroom. Studies were also included if they were deemed relevant because of data that supported the subtopic of student engagement and motivation related to online games or e-readers, or if they concentrated on successful integration of e-readers or online math games within the elementary classroom.

Study Description

Among the 30 articles that have been reviewed, seven of the articles reviewed examined the relationship between student engagement and achievement in regards to e-books and online math games (Jones & Brown, 2011; Ke, 2008; Plass et al, 2012). These studies focused on factors such as motivation, enjoyment, attitudes and modes of play such as collaborative, competitive, and individual and evaluated how these factors affect student achievement. These articles were included in an effort to answer the question, 'How does student engagement affect

student achievement in the area of online learning games and e-readers?’ Nine of the articles included in this review are the empirical studies examining factors affecting student achievement and how e-books and online math games affect achievement in the areas of math and reading (e.g., Ciampa, 2012; Kiger, Herro and Prunty, 2012; McClanahan, 2012). These articles, in which the researchers compared traditional instruction with instruction that included online components, or observed how the inclusion of digital tools affected student achievement were examined in order to answer the question, “How do online math games and e books affect student math and reading achievement in the elementary classroom?” Finally, six studies examined how e-books, online math games and technology in general could best be utilized in the elementary classroom, in order to provide recommendations for future implications, and assist educators in making decisions when considering these programs in their own classrooms (e.g., Hutchison, Beschoner, & Schmidt-Crawford, 2012; Hwang, Sung, Hung, Huang & Tsai, 2012).

Selection Criteria

The next step was an extensive examination of the articles, during which papers were excluded if they did not discuss the relevance of online math games and e-readers, in relation to student engagement, achievement and/or educational implication to a degree in which was significant to this review. Only peer reviewed article were selected, and only studies done within the last 5 years were considered when answering the question, ‘How does the use of online math games and e-books affect student achievement?’ Three articles dating as far back as eight years were selected to provide background on work that has been done in the area of digital games in education (Becker, 2007; Ke, 2008) and technology integration in the classroom (Harris, Mishra & Koehler, 2009). All studies except one included data about elementary students. One study

referred to middle school students, and was included as it contained relevant data about modes of play and how they affect student achievement in math (Plass et al, 2013). All relevant studies were considered regardless of the type of elementary classroom (special education, general classroom, home-school) or number of participants in the study. All research methods were considered in this review, as relevant.

Analysis and Discussion

Correlation between Engagement and Achievement

In order to answer the first question for this review ‘How do online math games and e-books affect student math and reading achievement in the elementary classroom?’, it is important to look first at one primary factor that has been proven to increase student achievement, engagement. Research evidence shows a direct correlation between student engagement and achievement (e.g., Ciampa, 2012; Jones, 2011; Ke, 2008), therefore it is important to consider how student achievement is affected by engagement within the context online math games and e-books in the classroom in order to understand the implications of this review.

Effects of on-line math games. Studies dating back to several years have concluded that when comparing traditional instruction with game-based instruction, the latter results in higher enjoyment for students, which may exert influence on a students learning performance (Giannakos, 2013; Ke, 2008). Using these studies and the information that they have provided the educational realm, many researchers have attempted to analyze student engagement in relation to online math games and e-books. Engagement, for the purpose of this review, can be defined as ‘active and collaborative participation’ (Trowler, 2010), however each study reviewed used their own definitions for determining ‘engagement’. Happiness, motivation and time on task were determined to be indicators of engagement in the following studies.

Giannakos (2013) set out to test the hypothesis that a students’ happiness with an educational game would contribute to a positive relation to their performance. In this study, two groups of 5th and 6th grade students were involved in the experiment, one placed in the ‘game group’ and one in the ‘traditional group’. Both groups worked on addition and subtractions

skills, with the game group using an online game, and the traditional group practicing with pencil and paper methods. After first establishing that both groups scored comparably on a test of general math skills, the researcher went on to investigate potential factors that may affect student performance; namely student attitudes. To analyze student attitudes toward the delivery of the math content, (digital and traditional), the researcher used a measure called The Visual Analogue Scales, in which students are asked to rate the degree of enjoyment, intention to use the game in the future, happiness, and performance. Using this measure, it was found that the only factor that had a significant effect on learner performance was enjoyment, and also that students found the digital games to be more enjoyable, which directly translated into better performance. The use of only one measurement to measure the students' attitudes, was limitation to this study, however, student conversations and comments were also recorded to add to the data collected.

Giannakos' study suggests Ke's conclusion that enjoyment can play an influential role in determining the knowledge acquired by the learner.

Ke (2008) conducted a well-designed experimental study to compare different types of game-based learning situations and to measure the 2nd grade students' satisfaction with the game itself, and also look at student performance related to that satisfaction. Students were placed in one of four groups for game play: 1) Teams-Games-Tournament Cooperative, 2) Competitive, 3) Individualistic, and 4) Control (no gaming). After 158 fifth grade students were trained on the four types of game play, they were required to play one math game (in which similar math skills were practiced) twice weekly for 40 minutes. After 4 weeks, students were given a 'Game-Skills Arithmetic Test' as well as the 'Attitudes Toward Math Inventory', in which students' self confidence, value, enjoyment and motivation towards math was measured. Findings indicated that the Teams-Games-Tournament group, which was the only collaborative game option, was

the only group that outperformed the control group in facilitating positive math learning attitudes, and was the only gaming group that was significantly more effective in terms of the math test performance. The use of only one type of collaborative learning situation, one specific online game, and one set of classroom goal structures may have been a limitation in this study, but the findings should encourage educators in the use of math gaming in a collaborative manner with a more well defined system in place (Ke, 2008).

Plass et al (2013) also set out to determine the effects that differing modes of play (individual, collaborative and competitive) in an educational math game might have on learning, performance and motivation. The game chosen for the study focused on arithmetic fluency for 5th, 6th and 7th grade students. The students were placed randomly in one of the three categories, and given the same initial directions about how to play the game. Minimal directions were given about how to collaborate or compete against one another, and all students were instructed to try to get the best score possible. All groups played the game for 15 minutes, and then played for 3 minutes individually as a posttest of game performance. They were also given surveys related to enjoyment, interest and future intentions to play the game. Results from the posttest showed that more math problems were solved, and performance was better when compared to individual play, in the competitive, but not collaborative game play. Secondly, when looking at the efficiency of problem solving strategies, the collaborative resulted in worse performance than both the individual and competitive play. Finally, both collaborative and competitive play increased situational interest and game enjoyment in relation to individual play. Situational interest is relevant, as it indicates that the students found the game personally relevant and reaches beyond simple enjoyment. It also is a good indicator that the student will want to play the game again in the future. It is important to note that the authors indicate that while the

data collected in this study point to the benefits of collaborative and competitive play to increase student attitudes in the area of math, the results cannot be readily generalized across all educational games. There are many genres of online games, and that must be taken into consideration when choosing one for the classroom.

In an effort to compare digital game based learning, and traditional learning strategies, Schaaf (2012), placed 3rd-5th grade students into two groups that would receive instruction either through the traditional instructional strategy, or through digital game based learning. The students participated in eight lesson cycles, and identical objectives and learning material was covered in each group respectively, according to the grade level and teacher lesson plans. Student observations were made during the lesson to determine time on task and engagement and the students were given an attitudinal survey at the end of the 8 lessons to rate their experiences focusing on engagement and enjoyment. Results of student observations made during the lessons, showed that seven of the 8 trials produced higher group averages for time on task behavior and engagement for the group placed in the digital game based learning sections. Six of the 8 trials showed a higher student survey average in the level of student enjoyment while experiencing digital game based learning, and six of the 8 trials produced equal or higher class average scores for focus and attentiveness during digital game based learning versus the traditional learning strategies. Limitations to this study might be that the lessons were taught in isolation from the regular curriculum, and only eight lessons were used in the data.

Effects of e-readers. In an attempt to determine the effects of electronic books on student engagement, Jones and Brown (2011) asked a group of 22 third grade students to read 3 stories, after which they were given a comprehension test about the stories, as well as a survey to measure their enjoyment of the reading. The first story they read was a mystery called “The

Boxcar Children” that was read in a small group setting from a traditional text. Next, the students were asked to read a mystery called “The Mysterious Wind” using the online reading program ‘Raz-kids’, again using the same small group method. Within the online story, the students were able to click vocabulary words for meanings, and there were sound effects related to the story’s plot. Finally, the students read another online story entitled “The Sweet Potato Challenge”, using the same program, Raz-kids, with the same features within the story. Findings showed almost identical scores on the comprehension tests for the 1st story (traditional) and 3rd story (e reader), and the enjoyment surveys indicated equal scores for enjoyment. The comprehension scores for 2nd story (e reader), however were significantly lower, and the mean enjoyment score for this story was also significantly lower. The correlation between student enjoyment and comprehension in this study indicates that student interest plays an important role in reading achievement. Another notable piece of data from the student surveys was the indication by the students that they were more motivated to read when given a wider variety of choices in reading materials, including e-readers, but not excluding traditional books. Students also reported a desire to read the online stories at home, which is also an indicator of motivation and reading engagement. These results suggest that when given a wide variety of choices and the opportunity to select books on their own does impact enjoyment, which as shown in this study can impact reading comprehension and student achievement. One limitation to this study that needs to be considered is sample size. One classroom of 22 students does not give a broad data base to use for future implications, but when considering the addition of e-readers in the classroom, the data collected indicating a higher level of engagement gives educators a positive beginning.

In a similar study, Ciampa (2012) investigated the effectiveness of online eBooks on 1st graders reading motivation by adopted mixed research methods. The students were asked to

participate in reading online storybooks from the website www.childtopia.com, in which the student could listen to the story, read it independently, and take a comprehension quiz. Each student spent 15 minutes daily with a teacher present during the sessions. Observations were made about on time on task, and engagement and the 'Motivation to Read Profile' were utilized both at the beginning and the end of the study. As with the study done by Jones and Brown, students indicated more satisfaction not necessarily with the online reading component, but with the ability to have more choices to read. Observations made by the teacher indicated almost 100% on task behaviors when the students were online, even for students who seemed to struggle focusing during traditional instructional time. Finally, after the students had participated in the online reading program, all students placed a higher value and importance on learning to read well. As the sample size was very small in this study, a larger scale study might be considered to follow up these findings.

Hutchinson, Beschorner and Crawford (2012), with the intent on providing foundational work for educators to begin making decisions about including devices such as the iPad into their curriculum, did an exploratory study on a 4th grade teacher and her integration of iPads into literacy instruction. Her goal for using the iPads was to continue to use print-based goals as outlined in her reading curriculum, but to enhance learning opportunities for her students through the use of the iPads. Each learning experience that was created was well thought out, and was based on the TPACK framework, (Koeler & Mishra, 2009). Using TPACK as a guide, in which the teacher's knowledge of their content, along with the pedagogical knowledge of how students learn comes together with the technology component, lessons were planned that included reading e-books on the iPad during silent reading time, using apps for comprehension and visualization of story themes, and using a drawing app for sequencing. Through the 3 week experiment,

students were highly engaged, and stayed on task 100% of the time when using the iPads for the planned lessons, as reported by the teachers who were observing the students. As this was a rather informal method for collecting data in regards to engagement, further research might be necessary to make deeper connections between the teacher's benchmarks and goals and student time on task. In this exploratory study, however, student engagement and enjoyment of the technology was increased by teacher preparedness, and solid understanding of how the devices could enhance her current curriculum.

Miranda, Johnson and Rossi-Williams (2012) wanted to assess student engagement during their silent sustained reading periods with reluctant readers in 6th, 7th and 8th grade. After giving the students a pre-assessment using the Motivation to Read Profile, they were given the option of reading e-readers or print books during the 40 minute period in their reading improvement class. Most students choose the e-readers, which were preloaded with 25 stories including classics, ghost stories and mysteries. After 2 months, the students were given a post-assessment to assess motivation and attitudes, again using the Motivation to Read Profile. The posttest found significant gains in students' attitudes about the value of reading and their view of themselves as readers, especially among the boys in the study. It is important to note that the researchers recognize that the novelty of the new gadget (e reader) plays an important role in motivation, and needs to be considered when looking at their results. They also point out, however, that this enthusiasm gave the students a reason explore the device first and then settle into reading, which in terms was the end goal.

Student achievement and online learning

Research shows that using online gaming and e books in the classroom has its benefits, including increasing engagement and motivation, but the question still remains as to whether

engagement equates to, or even affects student achievement in the area of math and reading at the elementary level.

Online math games and achievement. Kiger, Herro, and Prunty (2012) examined the influence of a mobile learning intervention on 3rd grade math achievement through the use of iPods. Four classrooms were included in the study, two of which were given iPods for daily multiplication practice, the other two maintaining the traditional practice using flashcards, paper pencil, techniques, etc. All iPods contained the same apps, and students were instructed on which apps to play each day. At the end of the 9-week intervention, both groups were given a posttest using the standard method of a paper-pencil test. Students whom were a part of the intervention group outperformed the control group on the post-test. The findings suggest that pairing traditional methodology in multiplication with a supplementary mobile device such as the iPod may be a way to improve student achievement. It is important to note, however, that the researchers implicate that effective implementation of the mobile devices, administrative and school commitment to the inclusion of the devices into the current curriculum, and adequately trained teachers are all factors that must be considered to replicate these results. It is also important to point out that a limitation of this study might be the small sample size, as well as the limited amount of instructional support during the times that students were playing the apps, which may have affected the students performance if they were unsure about the technical aspects of the game.

Conversely, Carr (2012) looked at the implementation of iPads in two 5th grade classrooms, where there was little teacher or student training on the use of the devices. Two classrooms participated, one in which iPads were presented as 1:1 devices, one serving as the control group, in which no devices were available. Both classrooms used the same traditional

curriculum, and each spent 60 minutes each day participating in math class. No specific use of the iPad was presented, and the device was simply a part of the classroom for the students to access whenever needed. At the end of the quarter, the students were given a post-test, covering the skills presented. Based on the results of the post-test, experiences with the iPads were not meaningful enough to significantly influence students' math achievement, indicating instruction with supplemental use of the iPad was not effective. The researcher suggests schools do not dismiss the use of mobile devices based on this study, but use it to further investigate teacher training, and proper use in the classroom.

In an experimental design study by Shin, Sutherland, Norris & Soloway (2012), the effects of technology-based games were compared to paper-based games in a 2nd grade classroom. Both types of the game focused on the same mathematical skills, and both groups played their game for the same number of minutes weekly for 5 weeks. A pre and post test was given to determine student achievement related to the mathematical skills practiced in both game types, and the results of the posttest showed the technology game group outperformed the paper game group significantly. To further expand upon this study, all students were then placed into the technology-game group, but students were randomly assigned to 3 groups, in which the frequency and duration of game play was different. Again, all students were practicing similar skills, the difference being the amount of time spent on the game. This extension showed that the more time spent on the technology based game, the better they performed on the posttest. Interestingly, however, in the meta-analysis of studies done by Chueng and Slavin (2012) to examine how the features of educational technology applications might affect student outcomes, student intensity, or the amount of time spent on an application related to reading, had no impact on student learning. More time spent did not equate to better student outcomes, according to the

84 studies analyzed.

E-books and achievement. In another study by Ciampa (2012), listening comprehension and oral reading was the focus. Again using 1st grade students, Ciampa asked 6 students to participate in a total of 12 e-book reading sessions during a 3-month period. The students were asked to use the read aloud feature, and were asked 10 comprehension questions at the end of each book. Ciampa composed the questions, and each story had 3 literal questions, 4 inferential, and 3 evaluative questions. The Gray Oral Reading Test was given at the end of the 12 sessions to evaluate the students' listening comprehension abilities. A Motivation to Read questionnaire was also given before the intervention began, as well as after the sessions. According to Ciampa's data, all students increased slightly in their comprehension of the e-books they were listening to, but no significant increases in comprehension were noted. When given the listening comprehension test, using the Grey Oral Reading Test, however, the total average comprehension scores dramatically increased from an average pretest mean score of 49.2% to a posttest mean of 71.7%. Finally, in terms of motivation, all students indicated a greater willingness to read online at home after the intervention, spent more of their free time reading, and at home logs showed an increase in time spent reading online. As this study was considered a preliminary investigation of the use of e-readers and motivation, the author suggests a larger, longitudinal study is necessary to understand the true nature of how e-readers affect children's reading outcomes when compared to traditional reading approaches.

In a study done by Wright, Fugett and Caputa (2013), the use of e-books vs. traditional print books was compared, with the end goal greater vocabulary understanding and a higher level of comprehension. The contention of the study was not to validate that e-books should replace paper books, but rather to determine whether students utilize the readily available technology

features of the e-books, and whether this alternative option to reading might be more effective. The students were in the 2nd grade, and each participant engaged in reading sessions that met 4 times over a 3 week period. The first and second sessions focused on traditional print books, and the third and fourth sessions focused on the e-books. The students read independently, and were shown how to access the technology resources on the e-books, and were instructed that they could use a dictionary or ask the researcher questions when needed during the traditional print sessions. Two sets of data were analyzed at the end of the study. The 1st set was the number of times the literacy resources were used by the type of reading method. The data indicated that the students used the resources on the e-books more than twice as often as with the print books. Secondly, the student's comprehension of the stories read was analyzed. Questions were given by the researcher and included questions relating to vocabulary from the story. The data indicated that there was not a significant difference in correct responses between the e-books and the print books. It is significant to point out that while there was no increased level of comprehension although the technological resources were accessed more often, when given a survey at the end of the study about which method of reading they enjoyed more, all participants indicated they liked the e-book better. A limitation of this study was the reduced number of participants (3). Further research is needed to investigate the effects of this study for students outside the particular eligibility criteria for this study as well, as all students had almost identical back grounds.

Although the research results are not published in a peer-review journal, Chiong, Ree, Takeuchi and Erickson (2012) at the Joan Ganz Cooney Center provide a unique insight about parental involvement in reading beyond the classroom. Thirty-two pairs of parents were asked to read a print book and an e-book together with their child. The researchers took three points of

data from the study. Firstly, they looked at the parent/child co-reading experience, and made observations about how the children and parents were interacting with the books, and whether their actions were content related (labeling, pointing, and verbal elaboration of the story) or non-content related (device focused, pushing hands away). In this portion of the study, it was found that when reading a basic e-book, or a print book there were more content related interactions than when reading an enhanced e-book, that had more features that were not directly related to the story. Secondly, the researchers looked at the story comprehension of each type of book (enhanced e-book, basic e- book, print book). Again, children who read the enhanced e-book, with more features, recalled significantly fewer narrative details than the children who read the print or basic e-book. Finally, engagement was measured in 2 ways. Overall engagement, a composite of parent-interactions, child-book interaction, parent-book interaction and signs of enjoyment showed that 63% of the pairs were as engaged with the print books as they were with the e-books (both types). Child-book engagement showed that children had higher levels of engagement with the e-books than with the print books. In this study, engagement did not necessarily equate to student achievement, because no measurement was conducted to make such a connection.

In a study conducted by McClanahan, Williams, & Kennedy (2012) about a pre-service teacher, who used an iPad as an intervention tool for a 5th grade student that was reading at a 2nd grade level, and struggled with ADHD, showed positive effects on the special needs student's reading growth. Several modifications, such as 1:1 tutoring, and reduced assignments had been tried with the student, with little improvement in his reading scores. The individualized self paced format of the iPad was determined to be a beneficial addition to the students current modifications. Over the course of 6 weeks, the iPad was used for reading ebooks, playing apps

directly related to the state standards for 5th grade, and a plan was created from assessments given before the treatment that outlined the student's specific needs for decoding, utilizing context clues and comprehension strategies. The inservice teacher also met with the students regular education teacher to discuss the lessons, and how they connected to what was being taught in the classroom, and the traditional teaching method was utilized in conjunction with the iPad lessons. For example, the student might be asked to use the INSERT method on a paper text 1st, and then be asked to use the same strategy using a stylus on an e-book. The student and inservice teacher met in 20 minute sessions at least twice weekly, working on reading skills directly related to the classroom skills being taught. At the end of the 6-week intervention, word recognition and comprehension assessments were given, and the student had grown one full grade level in reading ability. It is important, however, to note that although this student in this situation made large growths in reading ability with the use of the iPad, there were also other factors at play, including specific targeted lessons created for him, as well as 1:1 tutoring.

Fitzgerald (2012) wanted to investigate the effect of using online modules to teach students with learning disabilities the Word Identification Strategy. In this study, five students from the Odyssey Charter School in grades 5-8 who were performing at least 2 years below grade level were chosen to participate. The instructional delivery model for all students at the charter school involves online teaching with supplemental face-to-face teacher visits, therefore the students in this study did their coursework at home, with teacher support. Students were given pre and post tests in the areas of fluency, oral reading, comprehension as well as a curriculum based test that specifically analyzed the Word Identification Strategy that was the basis for the online modules. All students had significant increases in oral reading performance and comprehension, and slight increases in reading fluency. On the curriculum based posttest

the students demonstrated a 50-70 percentage point improvement in the number of words broken apart correctly. The incredibly small sample size, along with parent involvement in this study need to be considered, however when looking at the results of this study. Having no way to monitor parent support at home is a limitation, and must be factored into the increase in student performance.

Finally, Cheung and Slavin (2012), wanting to try to make sense of the current technology trends in the area of reading, completed a meta-analysis of several studies researching the effectiveness of online reading programs. While they found no magic bullet in any of the programs used and researched, they did determine that what matters in student achievement relating to online reading programs is how the technology integrates with the non-technology components of reading instruction. What did unify methods that had greater promise for higher student achievement were those that were used in close coordination with the teacher's efforts and curriculum. In addition, they recommend that schools and educators make concerted efforts to identify and adopt research proven programs to improve student achievement as well as close ability gaps.

Factors affecting success with online math games and e-books

The increased inclusion of digital based learning games as well as e-books, and online reading programs in today's classrooms has encouraged researchers to look at how they can ensure that educators are making the most out of this new supplement to their curriculum. Understanding that student engagement can increase student achievement, and that online resources have high engagement value, educators still need to consider factors that will ensure, or at the very least enhance, the use of these programs in their math and reading classrooms.

Learning styles and game types. Hwang et al (2012) suggest that matching a student's

learning style to the computer game can increase motivation, and thereby increase achievement. In the study, the performance of 5th grade science students who learned with personalized educational games that met their learning style was compared with that of the students who did not learn with games that met their learning style. Students were given a questionnaire about perceived usefulness and perceived ease of use, as well as given a posttest that examined their learning achievement. Results from this study showed that student's motivation when learning with games specifically aimed at their learning styles not only promoted a positive attitude towards the game, but also showed significant growth in achievement compared to the control group.

Research has also been done indicating specific features of digital games themselves that have an impact on their effectiveness in terms of engagement and achievement (Shin, Sutherland, Norris & Soloway, 2012). Games that provide clear and specific goals for their players support organizational thinking, and lead to enhanced performance and learning outcomes. Learner control, in which allow regulation of the learning activities relating to previous knowledge and experience also assists in creating an individualized learning environment to promote student learning. Having control over difficulty levels, topics and game strategies is an important aspect of subject matter mastery, motivation and positive attitudes. Games also need to offer tasks that are challenging, in order to motivate students to compete against and improve upon their own scores. Along with the task challenges, games should provide feedback to support the learner in reaching goals. That feedback should be encouraging and precise, in order to help learners evaluate their progress, and continue to set goals to improve in their own learning. Finally, research indicates that repetitive play and repeated return to the game over time allows learners to persist or intensify their effort to complete the tasks at hand.

Planning, correlation to learning goals, and support. Harris, Mishra & Koehler (2009) recommend using technology, pedagogy and content knowledge (TPACK) when integrating any technology into current curriculum in order to ensure a well balance approach, as opposed to a technocentric model that focuses solely on the device or program being used. They contend that understanding that the introduction of new educational technologies into the learning process changes more than just the tools being used, and educators need to consider content area learning, and pedagogy when considering digital learning opportunities.

Hutchinson et al (2012), suggest that proper planning can assist educators when planning to use technology to supplement their reading curriculum. They go on to suggest educators first determine the learning goals and make pedagogical decisions to determine the parameters of the each learning experience, then select the online tools to meet those learning goals.

In a study by McKenna (2012), two teachers learned quickly that pre-planning for the use of iPads in their language arts and math classrooms was a determining factor in the success of their implementation. Each teacher used iPads in their classrooms for a duration of 45 minutes, but also used traditional methods with the same students for the same amount of time. After each lesson (traditional or iPad) an assignment or assessment was given to measure outcomes. In both classes, there was significant growth in all three standards being assessed when using the iPads as opposed to the traditional methods. Although both teachers saw student achievement and engagement increase with the implementation of the iPads, it was clear that the pre-planning done on the teachers end was essential to the success of that implementation. Pre-loading of apps, iBooks and organizers allowed for fewer distractions and more focused practice during the iPad lessons. The teachers themselves stated that the use of the technology did not always equate to success for every student, but taking the extra time on the front end was worth it in the

long run for most students, as evidenced by the higher assessment scores.

Wouters and van Oostendorp (2013) used meta-analysis techniques to test if instructional support for both the student and the teacher could enhance digital-game based learning. After classifying instructional support, learning outcomes and the instructional domains, 29 studies were examined, with the intention of looking at types of instructional support and how that support enhances learning. With regard to multimedia learning environments, analysis of those studies showed that well designed instructional support for the student and teachers improves learning, as it can help learners to refrain from ineffective use of their own limited cognitive capacity, and allows students to focus on the learning component of the game, as opposed to the 'how-to' of playing the game. The meta-analysis also indicated that the effect on learning was greatest when the instructional support focused on helping students incorporate relevant new information or knowledge into their current schema.

Conclusions and Recommendations

Taking into account the current research on game-based learning, the evidence is clear that when implemented effectively, the use of online games (Kiger, Herro, and Prunty, 2012; Shin, Sutherland, Norris & Soloway, 2012) and e-books (Ciampa, 2012; Wright, Fugett & Caputa, 2013; McClanahan, 2012) in elementary classrooms can increase student engagement and thereby, in many cases, increase student achievement. Several factors leading to effective student engagement and its relationship to student achievement were observed in this review. It was established that student enjoyment, as well as the use of certain types of gaming that led to a higher level of student satisfaction with the game which in turn leads to higher student achievement (Ke, 2008; Giannakos, 2013), and the modes of play also was a good indicators of student performance when playing an educational math game in collaborative teams (Ke, 2008; Plass et al., 2013). Result from these studies give educators reasons to choose carefully when considering what games and apps they might want to incorporate in their classrooms. Knowing the types of games that lead to higher student engagement , enjoyment and/or motivation gives educators a good first step to making that choice. Research has also shown that student engagement directly correlates with student achievement, and research evidence show that the use of e-books resulted in more positives attitudes in the subject (Jones and Brown, 2011; Ciampa, 2012; Chiong, Ree, Takeuchi and Erickson, 2012). It was established in two studies that while students did not indicate a preference for e-books over traditional texts, student motivation and engagement increased as they were given more opportunities to make choices about what and how they read (Jones & Brown, 2011; Ciampa, 2012). Adding another engaging option for students in the reading classroom seems to be a logical choice, and studies in this

review support the notion that the use of e-books are engaging to elementary students. Students were also reported to be more on task when using online reading programs and e-books (almost 100% on task), and participating students surveyed placed a higher value and importance on learning to read (Ciampa, 2012), and getting students to be on task when reading is a goal that all teachers are constantly trying to achieve. And while studies are still lacking that definitively show that e-books equate to higher student achievement, it is important to note that there have been many studies done indicating that the more a student reads, the better reader they will become (Jones & Brown, 2011; Thoermer & Williams, 2012).

In terms of student achievement and the effects of digital gaming upon that achievement, it was clear in this review that when thoughtful consideration of how the digital gaming, e-books and apps will be used in the classroom is given before implementation, the results can be positive. In the case of a special needs student who made nearly a year's growth in the 6 month intervention (McClanahan et al, 2012), and in a regular classroom setting where the iPods were used in the 3rd grade math class (Kiger, Herro, & Prunty, 2012), the teachers and administrators took the time to specifically plan the use and supplementation of the games and devices, which led to a positive result in which the students scored higher than the control group on the posttest. It was also shown that the more time spent playing well planned games can be effective in increasing student performance, as was the case with the 2nd graders in Shin's study (Shin et al 2012). However, in the case of the iPads in a 5th grade classroom where teachers were given little direction, and the students did not have specific tasks given to them to supplement the traditional curriculum, there is little effect (Carr, 2012). This study showed how a poorly designed implementation of digital based learning can result in little to no positive results in the area of student achievement, and can be considered a 'what not to do' scenario for teachers. The three

studies (Chiong, Ree, Takeuchi & Erickson, 2012; Ciampa, 2012; Wright, Fugett & Caputa, 2013) in this review came to similar conclusions that although e-books tended to be chosen more frequently, and were a motivating and engaging aspect for students when reading in the classroom or with their parents compared to traditional print books, the e-books had no significant effect on the students' comprehension of the stories read. A more longitudinal study investigating the effect of more frequent use of the e reader is recommended to determine if comprehension might increase with more use. When considering e-books and online math games, it was also shown that when integration is closely tied to current curriculum and teacher goals, a higher level of student achievement can be measured (Chueng & Slavin, 2012).

Finally, the research in this review supports the use of learning styles when considering games for the classroom, as matching styles with the games proved effective in increasing student achievement (Hwang et al, 2012). Also, both supporting the teacher and students in the implementation of digital games, in terms of how to play the games, as well as how to successfully integrate those games into the current curriculum was shown to have positive effects on both student satisfaction and student achievement (Wouters & van Oostendorp, 2013). Also, taking time to plan the use of the reading program around learning goals was shown to have positive effects on both student and teacher satisfaction with the implementation (Hutchinson, Beschorner & Crawford, 2012). McKenna (2012) also found that student success can be greatly improved with pre-planning and organization as they implemented the use of iPads into the literacy and math curriculum. Lastly, making informed choices about the games and e-books used in the classroom can make a difference in student interest, engagement and performance, according to Shin, Sutherland, Norris and Soloway (2012). Not all digital resources are created equally, and students will respond positively to those made with features such as learner control

and challenging tasks in mind.

As educators move forward into the world of their 21st century learners, it is important to consider several factors and undoubtedly the use of online games and e-books within the context of their classrooms will be among those factors. It is clear that student engagement can lead to student achievement (Giannakos, 2012), and that there are ways to ensure success when implementing what many may consider ‘play’ to many into their curriculum (Ke, 2008). Teachers can rest assured that although it may seem like ‘play’, when done with fidelity and true consideration of students’ needs and teachers’ goals, online learning in the form of e-book and online math games in the elementary classroom can lead to greater student achievement. Continued research on specific games, apps and online reading and math programs would be beneficial to educators, as this review has shown that the more connected to teacher goals that online reading and math opportunities for learning are, the better the students will perform. More longitudinal studies are also recommended to measure the long-term effects relating to the use of online math games and e-books to student achievement.

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